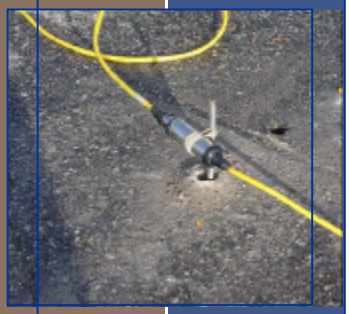
Technology Bulletin

Geophysical Method to Detect NAPL



The presence of non-aqueous phase liquid (NAPL) is a leading cause for the failure of remediation projects to address contaminated groundwater. The identification and characterization of residual NAPL is a critical step in developing a sound strategy to remediate contaminated groundwater. Without proper characterization of NAPL, remediation systems cannot be designed with realistic estimates of cost or site closure.

Earth Tech has developed a geophysical method using induced polarization to locate NAPL in aquifers. This method has been employed to identify both dense and light NAPL (DNAPL and LNAPL) with great success. This method is useful during the investigation phase to identify target zones for sampling locations. It is also valuable in reevaluating site characterization when a groundwater removal system is not achieving cleanup goals.

This method reduces the cost required to characterize the location and distribution of NAPL. Earth Tech has reduced project costs by targeting borings into areas that contain NAPL and also targeting perimeter borings in areas outside of the NAPL. Using the results of the geophysics optimizes the use of the investment in drilling wells, sampling groundwater and performing chemical analyses.

In addition, targeting the zones with NAPL reduces the risks associated with the implementation of the remedial design. Remediation systems that are installed without an understanding of the presence of NAPL cannot be designed to address the slow solution of NAPL into the groundwater. Improper characterization can lead to treatment times being extended by factors of ten to over one hundred, or the complete failure of the remediation system.

This is a new application of an existing technology. The method is conducted by passing an electrical current through the ground to induce a polarization in the ground. Induced polarization instruments measure the decay of the electrical potential after the current is no longer applied to the ground. The measurements are taken from a linear array of electrodes that provide information on the decay of the potential with depth along the line. Areas with NAPL and water tend to hold the charge longer, much as a resistant fluid in a capacitor causes the capacitor to hold a charge longer.

A few examples of the successful application of this technology follow.

EXAMPLE 1: LNAPL at an active rail yard. Diesel fuel had impacted fractured bedrock, and appeared to extend under an adjacent community baseball field. Induced polarization identified target zones 15 feet below the water table, downgradient of the release area. Initial monitoring wells were installed to the water table and did not contain any LNAPL. New monitoring wells were drilled to the target depth of 15 feet below the water table, where a fracture system was encountered in the bedrock. This fracture system provided significantly more water to the wells and contained diesel fuel that had migrated through the fracture system. The observation of LNAPL 15 feet below the water table significantly altered the understanding of contaminant transport and distribution at the site.

EXAMPLE 2: DNAPL at a closed chemical facility. Chlorinated organic compounds were released from a closed chemical site over 20 years ago. A groundwater collection system was collecting the impacted groundwater at the site, but concentrations in the groundwater were not decreasing. Induced polarization was used to provide target areas for drilling over a 200-acre chemical plant. The induced polarization focused the borings in areas with the highest probability of containing DNAPL. Areas with the highest induced polarization contained the most DNAPL, and lines with no anomalies were used to successfully place borings around the DNAPL area, defining the extent of contamination.

EXAMPLE 3: LNAPL at a closed refinery. A closed oil refinery sat on 20 feet of clay overlying a course, cobble formation. The cobble formation was not continuous, and the distribution of free product in the coarse layer was difficult to interpret based upon the borings that had been installed at the site. Induced polarization was used to provide information on the location and distribution of LNAPL in the clay and course layers. Soil borings confirmed that NAPL was present in the target zones identified by induced polarization. Some target zones actually extended to the ground surface, and hand digging methods confirmed the presence of NAPL very close to the ground surface in these locations.

Earth Tech can use induced polarization to assist with the characterization of NAPL during the remedial investigation phase. Earth Tech can also economically test the original assumptions on sites that have had groundwater pump and treat systems in place for extended periods of time and have not reached closure.

Points of Contact for More Information:

Jim Tolbert, CPG
Grand Rapids, Michigan
(616) 940-4231
JTolbert@earthtech.com

Robert Bradley
Grand Rapids, Michigan
616-940-4446
Robert_bradley@earthtech.com